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25 YEAR RE-REVIEW

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Mass-Production Processes Used in Making Detectors at NII 160

Preparatory Work.

Cutting the carbon rods, which when they are delivered are about the same length as pencil leads, and grinding the ends smooth (both operations in one machine), so that pieces 7.5 mm. long result. Diameter at first 1.5 mm., afterwards (about 1949 onwards) is only 1 mm.

Boiling in distilled water, drying.

Preparing aluminium shavings by paring them off a block.

Aluminium of 99.9 - 99.99% purity. Remaining impurity zinc, further details unknown.

Degreasing, washing, and drying the shavings.

Filling the reaction vessel, pumping and siliceting, as already described, with the addition of about 2 mg. boron.

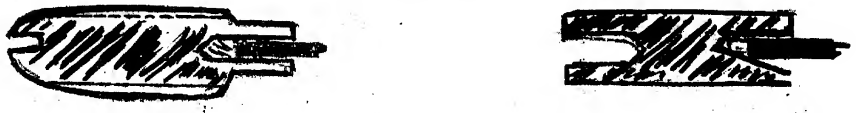
Testing the silicated carbon rods, when reaction has ended, with an oscillograph which records the crystal characteristic with 1 $V_{eff.}$ Sorting according to characteristic.

unusable	measuring and video detectors	mixers for 10 x 3 cm.	mixers for 0.8 cm.	unusable

decreasing boron content →

The usuable rods were kept in stock until wanted, then cut into 3 pieces of 2.5 mm. in length, the center piece, which has no silicated frontal surface, thrown away and the two end pieces embedded in the crystal holder with soldering tin. The crystal holders were screws with 3 mm. fine threads in the case of KD2 and KD3, with 2 mm. fine threads in the case of KD6 and KD8. The screws were later replaced by smooth bolts.

Sketch



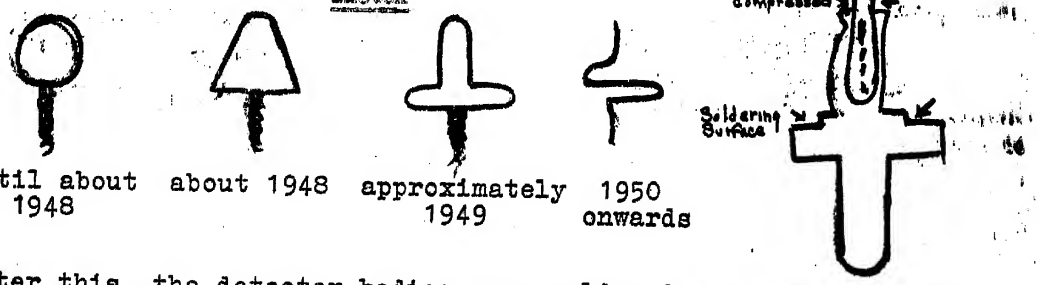
At the same time, the main parts of the detectors were prepared.

The nipples produced in an automatic machine were silver-plated and polished by means of drums.

The small ceramic tubes (already pressed and sintered) were coated on the frontal surface with a paste of about 95% molybdenum and about 5% iron powder in collodium; this paste is sintered on at about 1320°C. A paste of nickle powder in collodium was then applied over this layer and sintered on at 1100°C (?). The nickel layer was then dipped first in a zinc-chloride solution, then in a bath of soldering tin (50% Sn, 50% Pb), and thus tinned.

The spirals were made in the wire mills belonging to the valve factory; and were firmly compressed in the nipples. It was found unnecessary to improve on the last shape:

Sketch



until about 1948 | about 1948 | approximately 1949 | 1950 onwards

After this, the detector bodies were soldered successively at the two soldering points with a device having a small, pointed gas flame. The soldering tin adhering to the nickeled and tinned ceramic is adequate for this.

The detector bodies were then tested under water for tightness with compressed air (3 atmospheres); the ones which were not tight were soldered again, whereas the others were boiled several times in distilled water until no more chlorine with $AgNO_3$ was found (chlorine from $ZnCl_2$). After careful drying in a furnace the bodies were ready for installation.

Installing the Detectors.

Until approximately 1950, installation took place in two stages. The screws were inserted and the best possible characteristic curve set on the characteristic oscillograph. The best detectors thus adjusted were adjusted to the best H F properties in the centimeter wave apparatus.

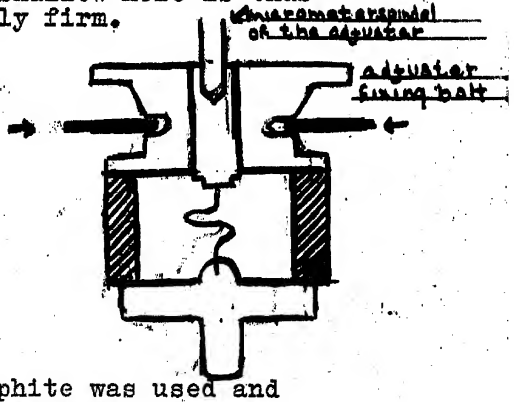
Later on, a change-over was made to a single-stage installation. An oscillograph was mounted on the centimeter wave apparatus, so that the detector could be either observed with the aid of the oscillograph or measured in the centimeter apparatus (change-over switch). Special installation equipment was made, with which the bolt (see preceding sketch) could be pressed into the body of the detectors with a micrometric impetus.

The working stages were, thus, as follows:
Change-over switch to oscillograph, empty detector body inserted in the centimeter apparatus, bolts with crystal screwed into the adjuster, adjuster with bayonet holder placed on the centimetric apparatus, bolts with adjuster pressed firmly into the detector body until the characteristic curve appeared on the oscillator.

Change-over switch to centimeter apparatus and by accurate operation of the adjuster the detector was properly adjusted to optimum HF efficiency.

Open bayonet holder of adjuster and take off adjuster. The detector is now suspended from the adjuster and can easily be unscrewed.

With several types, additional fixing of the bolts in the detector body was provided, two bolts operated by the eccentric on the adjuster were pressed into two shallow holes (Sacklöcher); the base of the shallow hole is thus distorted and the bolt held absolutely firm.



After adjustment the screws or bolts were sealed off with paint and dried in an oven at 50°C.

The finished detectors were then subjected to the usual JAN-tests.

Manufacturing Difficulties

Raw Materials

Carbon rods. Originally, Acheson graphite was used and there were no difficulties. Later, electrolytic carbon: great difficulties, as too impure. Meanwhile negotiations with carbon factory which delivered extrusion-pressed carbons of adequate purity.

Aluminium. Great difficulties until about 1949/50, as there was no pure aluminium to be had and the crystals were therefore impure. Then sufficient pure aluminium delivered in large blocks by another works.

Threads: The threads of the screws and nipples were never accurate. In spite of the best tools, the Soviet workers worked so badly that the screws either fitted too tightly or wobbled in the thread. The bolts used afterwards were calibrated as wire through a drawhole and fitted well.

Ceramic material: This was often porous and therefore not watertight, because the women workers pressed it too quickly, but a certain time is required for the pressure to propagate itself through the small tube. The end away from the rammer then receives too low a pressure and remains porous.

The molybdenum layer on the little ceramic tube must be sintered on at a temperature only about 10° below the softening temperature of the ceramic, otherwise it adheres badly, is not firm, or even peels off. As it was mostly too much trouble for the Soviets to measure this temperature exactly, sintering was often done at a lower temperature. The detectors were then not properly tight, or even broke apart.

Manufacturing Process

Silicating: It is necessary to work as clearly as possible, so that no harmful foreign bodies are incorporated in the crystal. In general, however, the Soviets have no idea what clean work means, so that in the course of time the crystals became worse and worse. For example, the high vacuum pumps were abandoned (for simplification) and only the rotary oil pumps used. The gases remaining in the reaction room produced a very undefined atmosphere which caused the quality of the crystals to deteriorate.

Adjustment: These bad crystals can mostly be used only with very small contact pressure at the point. But then the resistance to shock is bad, as is the burnout.

The woman workers also frequently altered the setting of the attenuators belonging to the high frequency installations (this giving somewhat better figures for the detectors) in order to obtain a higher percentage of "good" detectors.